DIDACTIC MATERIALS THROUGH ARDUINO SHIELDS TO STIMULATE PROGRAMMING MOTIVATION

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Abstract

Technology as a tool serves to encourage teaching above all in the programming area due to its complexity. The present research seeks to potentiate and motivate the students’ interest for programming, using didactic resources through Arduino shields. It will be achieved adapting the resources and the activities involved in the learning process in this field. A descriptive research, using empirical studies, was done to capture the students’ attention towards different applications of didactic materials developed in internet of things. In this way the research contributes to stimulate and innovate the teaching learning process, so that students and teachers may improve their attitude and aptitude while receiving the subject. For teachers is of paramount importance to foster the collaborative learning in an interactive environment. The results allow concluding that the teaching learning process of different themes in areas of technology, especially in relation to programming.

Keywords: Motivation, didactic resources, internet of things, Arduino.

1 INTRODUCTION

At a global level, countries have access to the new developing technologies that are continually in evolution in every field, but especially in education, technology is as a tool for stimulating and improving students’ motivation. But it is also one of the most significant problems at academic level which results from an inappropriate use of students and the community in general. The teacher has the challenge to detect the problems arising in a group of students and in individual students in any particular theme to solve them and provide feedback as needed.

"In recent times, the interest for the teaching and learning of computation languages has emerged in schools. It is a planetary phenomenon and of rapid widespread in the society. The massification of internet, social networks, mobile phones and the increasing importance of computation sciences have motivated- after 50 years- to a new perspective to understand the role of programming in education. Today, there are a higher consciousness regarding the fact that introducing the teaching of programming languages early in school generates cognitive impacts, facilitates the development of skills to solve tasks, promote the logic thinking and in general terms; empowering the students in the learning process. Programming has changed rapidly, from being a theme of specialists, it has become an important skill that digital natives should master at some level" \[12\].

The problems in the learning of programming are diverse, that’s why they require continuous research. There are also other factors derived from the very few mechanisms existing for the creation of computing programs which use programming languages and the inability to see the results of calculation when a computing programming is running and the difficulty to understand the compound logic \[7\].

This causes a lack of interest and little motivation among the students when developing skills to learn programming. Apart from that, most of the lessons are theoretical ones, the programming languages are not updated, there is a high level of complexity and lack of interactive didactic resources in the learning process.

In this respect, the use of new technological tools influences in such a way that it may modify the students’ effective perception and motivation. That’s why the use of teaching didactic resources, on one hand, improve learning and on the other hand provide conditions for the interaction among teachers and students within the teaching environment to get better formation results.

Internet in the present society, is a tool with a wider capacity of storing all the information we may seek. It is the resource most used nowadays, very effective to perform teaching with a high quality, so, teachers may assess the results and the progress the students are achieving throughout the course.
The use of internet is changing customs and habits of students and teachers as it has become an important mean as the main resource to teach and learn.

1.1 Theoretical background

Education at present is an education of evolution that have all the future technological changes implicit, many of the devices created for education aim at the future. The students must study to learn, to acquire knowledge for lifelong, in this sense, good knowledge is the result of good learning.

Learning starts in the construction of knowledge through techniques and tools which leads their own discernment of what is being research [4].

Students that are involved in this kind of learning, through the implementation of skills and cognitive techniques, can achieve better academic results because “Leading the students to reach auto regulation favours a more profitable learning strategy [5].

Information and communication technologies have changed the cultural paradigm at a global level, being education one of the field with higher contributions. It was benefited with these transformations, that’s why a comparison is made before and after the application of these elements in the teaching learning process [13].

In the past years, teaching and learning of informatics programming in schools contexts have been widely studied at international level.

Programming is found in our daily life and it can be learned and teach as any other subject through dynamic and motivating strategies which stimulate the students’ creativity and critical thinking. This kind of thinking functions as an intelligent mechanism for the development of skills and use as an effective mean the computer programming that, besides, is a coveted tool in any area of the labour market. Although these ideas were previously stated, at present they are being revised through innovative proposals, the great majority of the resources to teach and learn programming are available in internet, but in general they don’t have accessible guidelines for the web content. [11].

In the Latin-American educative context, the teaching of programming is present in different projects and educative policies. Although there is no evidence of comparative studies, there are pioneer experiences in different educative levels in various countries [14].

An important aspect in the teaching learning process of this subject is the motivation, where the teacher is an essential element to influence in the students and in this way they can develop their self-esteem, avoid the fear to make mistakes and above all, there is a need to receive instructions to fulfil their study goals. For that reason, teachers should plan their lessons thinking in new methods, strategies and activities to facilitate learning such as seeking for new software tools which provide the necessary scaffolding for beginners.

The internet of things (IoT) is the prototype that uses information and linked objects with the objective of giving use to the technology in a positive way.

The Internet of things (IoT) is a well stablished paradigm for a net of tangible and specific things that use the internet existence infrastructure to interconnect through different protocols, domains and applications [10]. The (IoT’s) are useful in different fields from which, there is no rule of use, simply it is based in creating to explore the knowledge behind the object [9].

The teacher plays an important role in the relationship and interactions within the classroom environment. In education, learning is a key component to move and educate as some authors state: the main advantages that teachers attribute to collaborative learning are related to the development of transversal competences, interaction among students and the development of curriculum. (p.2) [4].

The internet of things (IoT) can be developed in a wide field, with devices, in labour environments, of health, at home, among others.

Arduino is a content platform, software and content of open code with a global community. It is aimed at any person developing interactive projects.

Arduino has shield microcontrollers which can be programmed using Arduino Programming Language, that is an application or software where codes can be programming to be, then, transferred to microcontrollers, the projects performed in Arduino are autonomous. This software allows the interaction not only with the shields or microcontrollers but also with other devices which can be handled with different technologies such as Bluetooth contact, wifi and gsm [8].
The shields can be assembled by hand or requested already preassembled; the software can be
downloaded freely. The hardware reference designs (CAD archives) are available under the open source
license, that’s why you can adapt them to your needs.

It is thought for artists, designers, as hobby and for anyone interested in creating objects or interactive
environments (Arduino.cl). Arduino can "feel" the environment through the reception of entries from a
variety of sensors and it can affect the environment through the control of lights, engines and other
appliances.

Arduino technology is used to:

Develop: In universities is widely used in different fields of engineering, internet of things, robotics,
automation, art, design, and so others.

Teach and learn: In countries of the first world many secondary and even primary schools use them with
innovative techniques for crossed studies.

Play: Primary schools use toys designed with Arduino technology to introduce physical learning, logic,
building skills and problem solving. Arduino immersive educative environment promotes the creative
process through leaning based in projects, with an approach focused in in the student’s interaction and
group collaboration.

Arduino provides different functions for its environment design, in this program many activities can be
done going from the basic to the more complex ones, with this platform one can create, innovate and
above all, learn and have better knowledge of technological tools that were unknown before.

Thanks to the internet of things motivational instructional resources can be created to reduce
programming complexity, one of these platforms are Arduino shields, which can be used to create,
innovate and above all learn and have better knowledge of technological tools using mobile applications
[3].

The mobile devices are very useful tools for the society, with them one can send messages, call, browse,
research, etc. these functions are all pertinent to education [15].

With the constant increase of smartphones, and the use of a greater number of applications today it has
become a necessary tool to get appropriate information and manage different tasks in the educative
environment. Mobile devices are essential in our present way of life and in the pocket of every person,
so it may be possible to control mobile devices through these applications in an easy way.

For example, turning on and turning off the lights of a house of minimal conditions through a mobile
allow the people to improve his conditions of life.

An important factor is the operative system, in the case of android, that is a free system, several physical
devices may be integrated logically with the use of an Arduino card which has Bluetooth services
integrated, combining wireless technology with the development of new applications.

2  METHODOLOGY

The methodology used provides a way at educative level with the intention of applying learning
techniques to know the skills and deficiencies of the students, and motivate them towards the study
using the technology promoting in this way autonomous and updated education.

In this investigation didactic and strategic materials are provided for the learning of the programming
subject in which the attention of the students is reached in a practical and interactive way. A survey
was done in the Educativo Unit Vicente Rocafuente located in Guayaquil City, with a sample of 240
students of third year of high school of informatics specialization.

A research with mixed approach was carried out, with the collection and analysis of quantitative and
qualitative data, taking into account the possibilities to operationalize the variables of the study and the
strategies to solve the stated problem.

Different methods were applied to give scientific support and validity to the study such as bibliographic
analysis, field study, participation action and a descriptive study, the observation and the interaction
were also used to get a better knowledge of the problem. The survey applied to the population allowed
the identification of their needs, the theoretical interpretation and data collection and also the analysis
and interpretation of results to give solution to the problem.
3 RESULTS

- The great majority of the students, the 81%, consider that motivation is an essential part of education and learning and much more in the programming subject. Thus, teachers should get informed and use adequate technological tools to achieve interest and more attention towards the subject.

- The 75% of the inquired considers that the use of internet of things in the educative institutions would generate updated technological knowledge and would increase the students interest to learn programming.

- The 97% of the students would like to use mobile devices with different applications which allow a better understanding of programming and an increase motivation about the functioning of this applications in the mobiles.

- Nevertheless, the 60% of the inquired students expressed ignorance of Arduino tool and its advantages and benefits when applying it in the teaching of programming, so they showed interest in knowing its different applications.

Generally, there was evidence that the student’s motivation is an important aspect for learning, for that reason the applying of didactic techniques should be implemented systematically for teachers.

Technological tools applied by the teachers should contribute to the improvement of learning and the motivation towards the programming subject.

The internet of things should contribute to the motivational development and to find pertinent solutions to different problems arising in the learning process.

In spite of the ignorance in relation to the use of Arduino platform, the students are motivated to work with it as a didactic resource in programming learning.

The didactic strategy usually suggested for the teaching of technology is learning through projects, as it allows students to interact in specific and significant situations, stimulating the development of conceptual, procedural and attitudinal aspects.

The project method is based in the learning constructivist approach, where the student is the center of the formative process with the accompaniment of the teacher, thus the student become the manager of his own learning [16].

Three didactic resources were used to motivate learning, the first consisted on an alarm GSM with movement sensor, which allows the identification of any movement, the second was a robotic arm with a mobile application which allow its pliers to do different movements and the trunk to rotate on its base and finally a Bluetooth light was made through a mobile application, which allow the light to turn on and off according to the application.

![Figure 1. GSM alarm with movement sensor.](image)

GSM alarms are characterized by having a communication module for text messages which allow the sensor to identify any movement, in this case the alarm will send a message to the mobile of the person in charge of the alarm.
Figure 2. Arduino code GSM 1.

```c
#include <SoftwareSerial.h>
SoftwareSerial sim900(7, 8); // TX, RX del sim900
int duracion=250; //Duración del sonido
int fMin=2000; //Frecuencia más baja que queremos emitir
int fMax=5000; //Frecuencia más alta que queremos emitir
int i=0;

const int PIRPin = 2; // pin de entrada (for PIR sensor)
const int pinSirena = 9;
int pinSensorMagnetico =4;
int pirState = LOW; // de inicio no hay movimiento
int val = 0; // estado del pin Sensor mov
int val2=0; // estado pin sensor magnetico
int veces=0;

void updateSerial()
{
  delay(1000);
  while (Serial.available())
  {
    sim900.write(Serial.read());
  }
  while(sim900.available())
  {
    Serial.write(sim900.read());
  }
}
```

The diagram, where GSM technologies will be used, was programmed within Arduino application, once the alarm is activated it will perform the different functions, opening the door or activating the sensor.

Figure 3. Robotic arm

The robotic arm is designed to do different programmed activities through a mobile application which allows the pliers to do different movements and at the same time the trunk can rotate on its base.

Arduino codification is designed to manage servo engines in such a way that each of them has a maximum movement of 180 degrees.

Instructions were used only for their extension movements, throughout the codification this can be verified.

The diagram of what would be the mobile application is programmed to be used, it is a practical application and can be used in an open way.
Programming of each of its component can be performed in different ways either programming them or building the blocks which is an easy and interactive way of programming.

Through a mobile application the bulb will turn on and turn off according to the order sent by the application.

Arduino codification is shown in a basic diagram where the commands are programmed for the three functions of the bulb, which will be manage with the application.

Design stablished from the APP Inventor 2 to perform the mobile application with the Bluetooth technology to control the bulb.
The following blocks are illustrating the programming of each of the components of the application described. This kind of puzzle makes programming much more interactive for users.

The methodology applied is based on the learning of programming language implemented in Arduino to use mobile applications of any type and in applications that can be added to manipulate these devices. Various examples from this proposal related to the internet of things (IoT) will be given to the students, examples that can be developed according to the students’ needs to investigate, project, innovate and create. It is important that in each teaching period teachers try to vary them and include other interesting examples to avoid monotonous activities. In this way, at the same time the students learn they will be able to create their own ideas.

4 CONCLUSIONS

The internet of things will contribute to the motivational development in the students learning process during the lessons, where they may find pertinent solutions to any arising problem. It is also important to have a didactic prototype for themes related to technology. Its application in the classroom should be complemented with other types of materials and tools which use the virtues of information and communication technologies.

The results of the pedagogical validation of the different didactic materials, designed to facilitate integral learning of the programming subject through Arduino, oriented to high school education were satisfactory. The implementation of these devices in the class motivate the students towards the learning of new themes, especially those related to technology. This confirm the importance of integrating new
technologies in the pedagogical environment, as they promote interaction, autonomy, learning to learn and active participation of students in the formative process.

REFERENCES


